

Informal Economies, Information and the Environment

MATTHEW E. KAHN AND ALEXANDER S.P. PFAFF

"If household and firm activities are not observable by government, then they may not be observable by those affected by environmental degradation either.... [W]e have a regulatory challenge: when information is scarce, private bargaining is unlikely to suffice... and government will lack a basis for regulatory action."

Many less developed countries (LDCs) contain sizeable shadow economies. For example, informal economic activity constitutes perhaps 70 percent of the GDP of Nigeria and Egypt, and perhaps as much as 30 percent of the GDP of Chile, Costa Rica, Venezuela, Brazil, Paraguay and Colombia.¹ The magnitude of the shadow economy in these and other countries may have serious environmental consequences. Environmental regulators seeking to provide incentives for environmental protection and conservation, for example, face enormous difficulties in monitoring and enforcing laws in the shadow sector. Groups and individuals operating in this sector recognize that they are not likely to be held accountable for actions that degrade environmental quality. The lack of accountability and incentives to comply with strong environmental standards raises the possibility that parties operating in the shadow sector will engage in activities that threaten the quality of the environment. This includes activities that cause an increase in the number of hazardous waste sites, the degradation of local air and water quality, species loss and total greenhouse gas emissions.

¹See capstone article in this issue: Matthew Fleming, John Roman and Graham Farrell, "The Shadow Economy," *Journal of International Affairs*, 53, no. 2 (Spring 2000).

While informal sectors exist in all economies, the impact of unobserved economic activity on the environment might be more intense in developing countries for at least four reasons: first, as suggested above, the shadow sectors of LDCs are likely to represent a higher proportion of gross GDP than in developed countries; second, LDCs characteristically have more relatively rural and unpopulated areas, in which the inhabitants lack sufficient incentives (economic or otherwise) to motivate well-defined property rights;² next, developing countries are poorer, and thus their governments have fewer resources with which to monitor polluters; and finally, if environmental health is understood as a "luxury good"³ then developing countries may lack the motivation to develop institutions that expose shadow sectors to regulation.

Given the challenge shadow economies pose to environmental regulators, are there strategies that a well-intentioned government can pursue to mitigate environmental damage? This paper will investigate three major related questions:

1. How does the existence of shadow sectors affect the design of environmental regulation?
2. How might regulators set environmental policies if they had more information concerning economic activity within shadow sectors?
3. Could economic development (including income growth) and increased international trade help "lift the shadow" and thus aid environmental regulators in pursuing accountability?

In general, environmental economic policies should provide appropriate incentives for firms and households to reduce environmental degradation. Designed appropriately, such government intervention can guide markets toward outcomes that are socially preferable if, as expected, these actors ignore to some extent the environmental consequences of their actions. Appropriate intervention, however, may require expensive studies to gather useful information regarding actors in the shadow economy. Thus, regulators may choose not to gather this information.

Consider the underlying policy problems: firms and households make millions of choices every day which go unobserved by

² Looking across a country, county size often shrinks as population density and economic activity increase. Regulatory infrastructure per unit area is a function of activity levels (which creates a need to adjudicate more issues).

³ "Luxury goods" can be thought of as items for which demand rises significantly only at income levels where basic consumption has already been satisfied.

regulators and may have an impact on the environment. These are choices such as: the quantity and type of fuel to use; or, whether to dump hazardous wastes or dispose of them properly. If a regulator observed each activity and thereby knew how much damage was caused, they could provide appropriate incentives—facing polluters with the full costs of their activities. For example, this could be accomplished by instituting a tax equal to the environmental damage of each activity. Even in well-developed regulatory systems, however, it is costly (in time and money) to obtain information regarding all of the activities that occur, the damages they cause and the costs of reducing pollution. Thus, in shadow economies, where much of the economic activity is not officially observed, policy options may be quite limited.⁴

In the view of many policymakers and citizens, limitations on policy choices also arise due to an important tradeoff: environmental protection may hinder production and consumption.⁵ This is especially noteworthy considering the low levels of consumption in developing economies containing

⁴ The longstanding push by environmental economists for “market-based policy instruments” in place of “uniform standards” (or “command-and-control” regulations) reflects precisely this informational issue, given the reasonable assumption that different firms have different costs of controlling pollution. Command-and-control regulations are seen as inefficient, since they mandate that each firm takes the same pollution-control actions while an efficient intervention would trade off benefits and costs of regulation and thus permit different levels of pollution abatement by different firms. However, it’s not firm-specific mandates *per se*, which are the problem; if a regulator could observe each firm’s costs of pollution abatement, she could set different mandates for each firm. The problem is that for lack of such information, mandates are not usually differentiated in this way. Given the cost of getting this information and thus the likelihood that the regulator will lack this information, environmental economists push for policy instruments which provide firms with the right incentives to make use of their own, superior information about their own costs of pollution abatement. If the regulator possesses information about the benefits of regulation, this can allow for each firm’s action to equate its costs with those benefits, and thus for efficiency. If the regulator is not sure about the precise benefits but has chosen to implement a given environmental standard, this can allow for that standard to be achieved in the least costly fashion, an outcome which is often described as “cost-effectiveness.”

⁵ Some, notably Michael E. Porter and Claas van der Linde, “Toward a New Conception of the Environment-Competitiveness Relationship,” *Journal of Economic Perspectives*, 9, no. 4 (1995) pp. 97-118, argue that environmental policies can be “win-win,” and can increase not only environmental quality but also economic activity. The more common view among economists is that there may be occasional and small economic gains from such policies, but even if so, these are generally more than cancelled out by losses in economic activity. The view that we are normally trading off these net economic losses against the environmental gains from regulation has been put forth by many, including recently, Karen Palmer, Wallace E. Oates and Paul R. Portney, “Tightening Environmental Standards: The Benefit-Cost or the No-Cost Paradigm?,” *Journal of Economic Perspectives*, 9, no. 4 (1995) pp. 119-132.

substantial shadow sectors. For example, in New England, restricting fishing to protect fish stock lowered incomes and increased unemployment among fishermen. A ban on logging to protect the spotted owl likewise encountered great resistance from logging communities in the northwest United States. Both of these cases highlight the difficulties in designing and implementing environmental policy, even in developed countries. Likewise, an LDC government seeking to restrict entry into a tropical forest in order to protect species may threaten the well-being of those generating income—or subsistence—from the forest. Without suggesting how a society or policymaker should value any of these, it is important to remember the tradeoffs inherent in making environmental policy.

This paper considers the set of strategies available to an environmental regulator with limited information. We study how the existence of large, informal sectors affects the choices that regulators make in limiting environmental damage, and then consider the effects of economic growth on environmental quality, including the possibility that growth may actually promote the formalization of what might otherwise be “shadow” sectors. After more fully describing some underlying policy problems, we consider policymaking conditions distinguished by the amount of information available: policies made without information; policies made with limited information; and policy situations in which more information is available.

ENVIRONMENTAL DEGRADATION IN THE ABSENCE OF REGULATION

To judge the benefits of environmental regulation, it is important to imagine the environmental consequences of an average person's daily behavior in an economy that features no regulation. In an LDC, bathing and cooking breakfast requires high-polluting fuels, such as coal, wood, or even dung, which are cheap to purchase but will increase local air pollution. Commuting to work contributes little to local air pollution if one walks; while a person who rides a bus or drives a car will contribute to local air pollution and global greenhouse gas production. A manufacturing job may contribute to water and air pollution. After work, a fish dinner may be provided by fishing that is unregulated at the local lake. This lake may be polluted by runoff from the household's daily water use, perhaps threatening the health of the future fish stock and its consumers. In cooking this dinner and in keeping his home

comfortable in the evening, additional polluting fuels are consumed. Thus, in the absence of regulation, while some will act responsibly in their own visible environment, few will recognize, or care, about the environmental consequences their actions have on society at large.

Most households recognize that they contribute to pollution, but they are likely to view themselves as too "small" to make a difference. Each driver in Los Angeles contributes to local smog levels, but if any one driver reduced miles driven, air quality would improve by almost zero. Such effects therefore seem easy to ignore, but as a whole, households impose significant negative externalities on the environment (that is, imposes costs on others). The social costs of driving choices therefore exceed the private costs, and private choices can lead to socially undesirable outcomes.

These facts suggest that government action is needed to avoid the damage caused by such externalities. The Coase Theorem, however, suggests that socially efficient outcomes may be achievable even in the complete absence of government regulation. It posits that as long as parties on either side of the debate have strong property rights (that is, a right to pollute, or a right to not have one's environment polluted), and so long as those affected by externalities bargain with those whose actions cause the external effects, socially efficient outcomes will result.⁶

When the conditions of the Coase Theorem do not hold though, externalities will yield social inefficiency. In many cases, it simply is not feasible, or too costly, to encourage bargaining between sides. For instance, it is difficult and costly for a fisherman in the Gulf of Mexico to determine precisely which parties are responsible for agricultural runoff that pollutes the Mississippi River (which in turn, pollutes the Gulf) much less to actually bargain with them.

For shadow economies, high costs of bargaining between parties play a crucial role. If household and firm activities are not observable by government, then they may not be observable by those affected by environmental degradation either. Thus, while an affected household could in principle identify a polluting firm and offer to pay them not to pollute, the prospect of doing so is bleak. The costs of finding the firm, and the difficulty of enforcing

⁶ In particular, it does not matter who has good property rights; the efficient outcome should result from bargaining. Of course, the party possessing the property right determines who makes the payment in order to permit shifts in the outcome.

such a deal, may be too great.⁷ Thus we have a regulatory challenge: when information is scarce, private bargaining is unlikely to suffice between households and firms and government will lack a basis for regulatory action.

Finally, we should place this likely environmental degradation into a few distinct settings. Rural settlers may degrade common property such as forests and lakes. Urban households may pollute the local water supply, exposing a large population to high pollution levels. This local effect may be observable. Urban firms may emit particulates into the air, affecting towns far away who will not be able to identify the pollution source. An energy sector such as China's may affect the entire global population because they choose to use cheap high-carbon coal, thus increasing global greenhouse-gas emissions. In all cases, the decision-makers recognize that the "shadow" provides "privacy" for polluters, such that they will not be held accountable for their actions.

ENVIRONMENTAL POLICY "IN THE DARK"

If we assume that regulators have no information about household and firm actions, then these actors are unlikely to be held accountable for the environmental harm they cause. Consider the examples of forest degradation and lake fishing. Nations may be able to conduct a yearly inventory of environmental assets using satellite photos of forest cover or sampling of fish stocks. However, the government will not know who or what is generating the changes in those forest or fish stocks and therefore can not take actions based on individual acts of degradation.

Suppose that households can fish each night without being detected, and that this seems reasonable from their perspective; their catch would not appear to threaten the supply of fish. Further, if the fish stock is being depleted, and if this household does not catch the available fish, then somebody else will. In aggregate, this can lead to socially inefficient outcomes, such as a complete and irreversible elimination of the fish stock, even in cases where many could have benefited from that natural fish resource in the future, if it had been managed well. What then, can the regulator do? They may wish to raise the price of access to the lake, for

⁷ Here we assumed that governments and citizens would have the same information regarding polluters. It is also possible that private citizens who are affected will have better information, in particular, if they live near polluters.

instance, through a user fee. However, if they can not observe the use of the lake, this fee can not be enforced.

Nonetheless, the regulator may be able to raise the "price" of access, for example, by banning actions that lower the costs of access and egress. For example, the government could ban the construction of roads leading to the lake. If access costs are increased, the net benefits people receive from lake fishing will diminish, and thus, fishing would be discouraged. Naturally, this approach may not always work, for instance, if local users access the lake by alternative means.

Generally, though, increasing the costs of access, or increasing the benefits of being somewhere else, affects environmental outcomes. Consider the construction of roads in the Brazilian Amazon, which in the past have intentionally been constructed into relatively unpopulated, forested areas to "bring people without land to land without people."⁸ This surely reduced the costs of access to the region, and raised the returns from economic activity (by lowering the costs of inputs from distant markets, and raising the net prices of outputs sold to the markets). Some argued, however, that the roads were not a big factor. Pfaff,⁹ though, finds that roads were significant determinants of deforestation in that region. That is, access costs did affect degradation.¹⁰

The study also found that the effect of increases in population on the forest decreased with the number of people already present. This suggests that for a given total population, aggregate impact on the forest is smaller if the population is concentrated in a few locations.¹¹ If that is the case, then for spatial planning, perhaps good roads should be built between existing cities, (instead of out into pristine spaces). Further, one might wish to make non-forest areas look relatively attractive, for example, by redirecting subsidies

⁸ Susanna Hecht and Alexander Cockburn, *The Fate of the Forest: Developers, Destroyers, and Defenders of the Amazon* (London: Harper Collins, 1990); provide this cite from General Emilio Medici, and further quote General Golbery de Couto de Silva as referring to "vast hinterlands waiting and hoping to be aroused to life and to fulfill their historic destiny."

⁹ Alexander S.P. Pfaff, "What Drives Deforestation in the Brazilian Amazon? Evidence from Satellite and Socioeconomic Data," *Journal of Environmental Economics and Management*, 37, no. 2 (1999) pp. 26-43.

¹⁰ Note also that in preliminary work on land use and deforestation in Costa Rica, Kerr, Pfaff, Sanchez and Boscolo (1999) also find that roads, along with ecological conditions, are a significant determinant of the forest stock.

¹¹ Here it is important to remember that the environment has multiple dimensions, and that an action, which lessens the expansion of the area, used for rural production could lessen forest degradation but increase some other form of degradation. For instance, where the population becomes densely concentrated, air and water may get polluted. See Pfaff (1999).

to support dispersed agriculture. This policy would support jobs in the urban areas.

Would the relative benefits of living in urban areas, instead of rural areas, significantly affect land use, and thus, forest degradation? Pfaff looked at historical urban development in New England.¹² Around 1830, the population started to urbanize and spatially concentrate within cities. This was precisely the time when a revolution in transport (railroads, canals and steamships) improved the links from New England to the Midwest, which reduced transport costs. The agricultural productivity of the Midwest and the drop in transport costs meant that agriculture in New England, that is, production outside the cities, became unattractive. Thus, people concentrated within the cities as the region became more industrialized. It appears that this shift in the relative benefits of producing within cities (rather than outside) in turn permitted the return of New England forests, which had largely been cleared. Thus, changing incentives for location can affect the level of degradation. While this outcome was not the result of a planned policy, it demonstrates the potential for policy options.¹³

Such stories concerning the environmental impact of 19th century US urbanization may be relevant for developing countries. Rapid urbanization is ongoing in these countries, as they solve sanitation and water supply issues and education levels rise. Urbanization and reduced fertility may reduce the number of potential participants in the rural shadow economy, thus reducing pressure on resource extraction in the countryside. While development economists have long bemoaned rural-to-urban migration for various reasons, in the spirit of the New England case, we note that one environmental benefit of this type of urbanization is a reduction in rural degradation. This is significant if the environmental assets of greatest value, or those, which are most difficult to protect, exist in rural areas. However, as suggested above, urban environmental problems also exist. For example, as more people move to Santiago or Mexico City, air quality is further

¹² Alexander S.P. Pfaff, "Benefits of Urbanization as UnSprawl: The Return of New England Forests," submitted to *Journal of Urban Economics* (2000).

¹³ See Matthew Kahn, "The Silver Lining of Rust Belt Manufacturing Decline," *Journal of Urban Economics*, 46 (1999) pp. 360-376, which provides yet another example of environmental outcomes affected by re-location. Here, competition from abroad makes manufacturing in the "Rust Belt" unprofitable. This relocation improves air quality in that area.

degraded and more people may be exposed to high levels of pollution.

Finally, current environmental policy debate can be cast in terms of how these types of problems affect individual decisions, and thus, environmental outcomes—even in the presence of complete “shadows” over environmental regulators. For some time, analysts have advocated helping rural producers “intensify” production, for example, by using fertilizer to raise the yield on the land they are using, but to use less land, and thus clear less forest. Recent arguments of this sort use logic akin to the arguments noted above. While a higher yield may lead to expanded production and, also, environmental degradation in the region where producers are already located, it might lower the incentives for producers to move elsewhere and begin degradation anew.¹⁴ Thus, the current location is viewed much as urban areas are above; that is, aiding agricultural intensification is similar to providing subsidies for urban employment—both try to make one location look better in order to discourage migration elsewhere.

This section has focused on regulation “in the dark.” In reality, no national economy features complete information “shadows” across all sectors. Imagine, then, a nation in which 60 percent of economic activity can be observed by the government (and is taxed and regulated), while the other 40 percent is “in the dark.” This heterogeneity of information across sectors raises another point about the location choices of polluters and the resulting environmental consequences: attempts to enact more stringent regulation may drive environmentally damaging activity “underground,” or “into the dark.” Evidence that regulation can induce “migration” of this type (to less intensely regulated locations) is found in the United States. Due to differences in geography and in the spatial agglomeration of economic activity, some areas such as Los Angeles feature much higher air pollution levels than other parts of the nation (such as Idaho). The Clean Air Act focuses its regulatory intensity on areas featuring high population levels and high pollution levels. An unintended consequence of this regulation offers an incentive for dirty manufacturing (such as the inorganic chemicals industry) to

¹⁴ For example, this argument appears in Anna Almeida, Luiza de Ozorio and João S. Campari, *Sustainable Settlement in the Brazilian Amazon* (New York: Oxford University Press, 1995) p. 189.

migrate to less intensely regulated areas. For example, Kahn reports that greater growth in county manufacturing employment occurs in counties where air quality is not monitored, (which serves as a proxy for regulatory intensity) relative to counties that do monitor air quality.¹⁵

ENVIRONMENTAL REGULATION "IN THE SHADOWS"

The previous section focused on the scenario in which regulators' knowledge about what occurs within the shadow sector is extremely limited. In this section, we study a scenario where the regulator can direct resources in order to gain improved knowledge about polluter activity. We will assume now, that both environmental regulators and private citizens have some ability to observe, and perhaps contract (or base punishments upon) the activities of polluting households and firms. For instance, it may be possible for a regulator, at some cost, to identify a firm that has violated an environmental regulation. In addition, it may be possible for groups of private citizens, such as an environmental non-governmental organization (NGO), to associate emissions to a given firm.

If a regulator can randomly audit a firm and generate enough information to determine whether that firm is emitting in violation of an environmental regulation, then the firm will have an incentive to comply with the law.¹⁶ This facilitates production of additional information. Pfaff and Sanchirico show that in principal, the firm can be provided with an incentive to produce information regarding its own compliance status if it receives an offer of lowered fines for violations (when the firm produces the evidence of violation).¹⁷

¹⁵ Matthew Kahn, "Particulate Pollution Trends in the United States," *Regional Science and Urban Economics* (27 February 1997) pp. 87-107.

¹⁶ Note that with limited resources, such audits are not going to cover many firms, nor is an audit going to be able to consider all of the many substances that could be emitted in violation of a regulation (this is true even in the United States today; see, for example, testimony by John Aloysius Riley, Director of the Litigation Support Division, Texas Natural Resource Conservation Commission: "Resource-restricted environmental regulatory agencies are not capable of inspecting every regulated entity on any regular basis...governmental resources are spread thin" (21 May 1996, before the Senate Committee on the Judiciary, Subcommittee on Administrative Oversight). However, a firm does face some chance of a large fine (note that the fine would have to be large for the firms expected fine to be large enough to give a real incentive, since the probability of being caught in violation will be low, as just discussed).

¹⁷ Alexander S.P. Pfaff and Chris William Sanchirico, "Environmental Self-Auditing: Setting the Proper Incentives for Discovery and Correction of Environmental Harm," *Journal of Law, Economics & Organization* (forthcoming 2000). The authors' analysis was tailored to US circumstances.

In particular, risk-averse firms may prefer to pay a smaller fine with certainty, versus taking the risk of a larger fine. Thus, they may be willing to make use of their superior information regarding their own emissions and compliance status in order to enhance the regulator's audit efforts.

This benchmark scheme would lower the fine proportionally to the amount of self-investigation conducted by the firm in order to determine compliance status. However, in a shadow economy it may be impossible to observe the level of investigation conducted. Still, using observable substitutes for an equal amount of self-investigation could provide incentives for firms to produce information about their compliance status. Briefly, three such proxies are:

1. A random audit (versus a whistleblower mailing information generated by the self-investigation to the regulator);
2. An announcement of the findings and provision by the firm of its self-investigation; and
3. The clean-up behavior undertaken by the firm.

The idea, however, of providing incentives for firms to generate more information than the regulator would otherwise receive, appears to be generally attractive. One limitation in developing countries is that these activities would likely take place solely within the urban sector (that is, not within remote, empty regions) since only in that setting would the initial possibility of being caught by random audit apply.¹⁸

Given the partial visibility of household and firm activities, it is not only the government, but also citizens and non-profit organizations that help to "roll back the shadow" and push toward better environmental outcomes, (which also leads to more efficient social outcomes if environmental consequences have been ignored). If information concerning polluter emissions or environmental degradation is costly for the regulator to collect, then concerned citizens can play a key role in providing the regulator with key information. Households that are located next to a polluting factory have a comparative advantage in monitoring that factory

¹⁸ Another limitation on applying this to developing countries featuring large shadow sectors is that small informal sector firms may not have the capital to finance regulatory mandates. See, for example, Allen Blackman and Geoffrey Bannister, "Pollution Control in the Informal Sector: The Ciudad Juarez Brickmakers Project," Resources for the Future Discussion Paper 98-15 (February 1998).

(in contrast to an environmental bureaucrat located in the nation's capital, hundreds of miles away). Recent World Bank research has focused on the role of NGOs and local media in generating information about local polluters and their emissions.¹⁹

Indonesia's *Proper Prokasih* program provides an example, in which polluters are assigned one of five colors signifying their degree of environmental friendliness. In a highly publicized report, polluting factories suffer a "Day of Shame" if they are reported as being polluters. As a result, factories that care about their reputation have an incentive to become more "green." As the World Bank research points out, firms do not operate in a social vacuum. Polluters may face demands for compensation by community groups, social ostracism of firm employees, threats of physical violence, boycotts or negative publicity. Thus, a regulator, by using the information on levels of pollution can in a sense deputize local citizens to hold polluting firms accountable for their actions. Other nations such as the Philippines, Mexico and Colombia have initiated similar programs. These information-based policies are useful in shadow sectors, because they increase accountability.

More generally, there is now a growing trend in which nations are using information as a regulatory mechanism. For example, the Toxic Release Inventory (TRI) was started in 1986 in the United States in order to empower the local constituency. The TRI mandates disclosure of toxic releases and transfers by US industrial facilities. Substantial penalties are imposed for failure to comply with reporting requirements. Thus, the TRI is a public information tool. Using the TRI as objective evidence, local governments and citizens can use this information to take actions, such as filing a lawsuit against a local polluter. While informing citizens and consumers may well have real effects, we should investigate systematically whether a TRI does in fact have substantial effects.²⁰ Note that the TRI itself is an example of the regulator taking self-reported data on firms' emissions and sharing this information with local concerned citizens. Shadow economies present the opposite scenario. The regulator knows nothing about

¹⁹ World Bank at <http://www.worldbank.org/nipr/greening/bkground.htm>.

²⁰ For instance, Linda Bui and Christopher Mayer, "Capitalization and Regulation of Environmental Amenities: Evidence from the Toxic Release Inventory in Massachusetts," (1999 mimeo) look at housing prices for an indication that the release of TRI information affects the desirability of living in a given location, but find essentially no indication that this is the case.

what is going on in the shadow sector while households living near the polluter may possess better information. Ideally, concerned citizens should “build” the data set for the regulator, which would help to identify the heavy polluters. Armed with the information from these informal audits, which aggregates reports of concerned citizens, the regulator then could take steps to mitigate environmental externalities.

IS INTERVENTION NEEDED?

We might even ask whether, given citizen action and an activist media, environmental regulators are needed for socially efficient outcomes. Looking again at the research, we note potential problems with over-reliance on citizen-based environmental monitoring. In some nations, such as Brazil and Indonesia, the government undertakes little inspection, but responds to citizen complaints. One clear problem that this method presents is that citizens complain only about what they perceive. Yet not all environmental hazards are perceived. In China, World Bank research documents that citizens are not complaining about invisible hazards. Despite the fact that experts who work for the government may have the technical ability to conduct complex audits and detect such hazards. While citizens could in principle hire experts, it may be that when expenditures are involved, collective action failures become significant. That is, individual households may “free ride” on others’ contributions. They may not take private costly actions to monitor a local polluter, hoping that someone else will bear the auditing costs.

In considering whether further regulation is needed “in the shadows,” we might revisit the Coaseian idea of bargaining and cooperation (which occurs between the actors causing the problem and those affected). If household and firm actions are to some extent observable, then perhaps different parties could contract with each other to achieve socially efficient outcomes.

First, private citizens may be able to obtain and use more information about the activities of other private citizens than the government. Compared to a national government, which may be located in a distant urban center, NGOs and the local media may have an advantage in collecting valid data. The Grameen Bank in Bangladesh provides a fine example of how to use information as an advantage to providing incentives. At Grameen, peer monitoring and credit contracts make groups of citizens jointly liable for each

other's debts. These characteristics strengthen the ability of the bank to extend (micro-) credit productively where other actors have failed due to informational problems.

Second, citizen groups possessing information regarding each other's activities can interact to efficiently manage a commonly owned resource (especially when their information is of better quality than that possessed by the government). Empirical evidence suggests that this can indeed happen.²¹ The Montreal Protocol on Substances that Deplete the Ozone Layer and subsequent actions regulating ozone-depleting chemicals serve well as evidence that given some information, countries can participate in cooperative arrangements that are similar (even countries with large shadow sectors). While this may not happen, the possibility of cooperation contrasts with our gloomy assumptions about degradation in the absence of centralized public regulation.

Providing theoretical support for this idea, Sethi and Somanathan²² note that cooperative behavior could arise, such as in the ways mentioned in Dasgupta's discussion of the literature:²³

1. Communities may function like small states with authority structures sufficient to coerce individuals;
2. Cooperation may be in equilibrium in a game-theoretic structure with the threat of sanctions in a dynamic setting; and
3. Self-interest may be superseded as a motivation for behavior by norms internalized by community members.

The authors then provide a distinct theoretical explanation for why such cooperation arises; one that can be seen as a framework for establishing which norms can be internalized. They demonstrate that cooperative behavior guided by social norms of restraint and punishment can be stable, despite the potential for self-interested behavior. While price, technology and social parameters may cause this sort of cooperation to collapse, it is worth noting the potential for stable cooperative equilibria.

Thus, given less-than-complete shadow economies, regulatory

²¹ See E. Ostrom, *Governing the Commons: The Evolution of Institutions for Collective Action* (Cambridge: Cambridge University Press, 1990); and D. Bromley et al., eds., *Making the Commons Work* (San Francisco: ICS Press, 1992).

²² R. Sethi and E. Somanathan, "The Evolution of Social Norms in Common Property Resource Use," *American Economic Review*, 86, no. 4 (1996) pp. 767-788.

²³ P. Dasgupta, *An Inquiry into Well-Being and Destitution* (New York: Oxford University Press, 1993).

initiatives along with private information provision and private cooperation offers hope for avoiding socially inefficient outcomes. However, while both private approaches offer hope for doing so without government intervention, the World Bank perspective on the experiences with information-provision, and the fact that private cooperation depends on a certain set of socioeconomic conditions, suggests that social efficiency may depend on regulation.

For the government, technological advances, such as recording emissions with remote sensing technology, may offer new opportunities to “lift the shadow” by reducing the cost of learning about the degradation caused by the shadow sector. In some developing countries, such as Peru, it has been estimated that over 80 percent of the bus fleet are part of the shadow economy. Since the transportation sector is a major contributor to local particulate and smog levels, this suggests that environmental regulators may have little ability to reduce overall emissions through regulations. However, engineers have designed remote-sensing devices that would allow the authorities to locate high polluters. This may permit the appropriate incentives for bus owners in Peru; if they know they are likely to pay a hefty fine if ticketed for an “emissions violation,” bus owners may purchase cleaner buses and maintain them better. Thus, lowering information costs through technology can have significant effects on environmental outcomes.

DEVELOPMENT AS A WAY OUT FROM UNDER THE SHADOW?

Developed countries feature more environmental regulation and smaller shadow sectors than LDCs. Does development, then, improve environmental quality by reducing the shadow sector and allow regulators to tackle observable environmental externalities? Macroeconomic research has documented the growth in per capita real income within and across nations—and that such shifts can have real effects. Note that a nation whose GNP grows at 3 percent per year will double its per capita income in 24 years. But does economic growth generate the information necessary for effective regulation?

Consider first how individuals will react to increased income in the absence of regulation. As often pointed out by environmentalists, the typical household consumes more as income rises. This suggests increased environmental degradation as incomes

rise. Another effect of income growth though, is an increased demand for higher quality products and a higher quality of life, which even economists recognize is not fully measured by consumption of marketed goods. As nations become wealthier, individuals may choose to exercise their options to incur extra expense on environmental preservation and protection. This individual-choice behavior leads to shifts both in how goods are made, and in which goods are produced and consumed.

It is important to recognize that the overall effect of economic growth is not clear. For instance, improvements in quality of life may result from increased consumption of market goods. Economic development can lead to degradation of environmental quality because the economy may become industrialized as a result of generating jobs for the consumption lifestyle that people demand. For example, if production involves more heavy manufacturing and consumers demand more vehicles per capita, the environment will suffer from economic growth. In this way, the demands for environmental quality of life and for increased consumption can be opposed.

Environmental regulation appears to be more likely to be enacted and enforced in wealthier nations. In the United States, for instance, the Environmental Protection Agency came into existence only in 1970, following a period of post-war prosperity. Further, the regulatory apparatus and budgets that render regulations less like "paper tigers" (compared to other countries' tough-sounding laws) have only evolved over time. It is a commitment to infrastructure behind the laws that generates the information needed for enforcement. And again, the fact that this was a set of politically viable actions would appear to be linked to increases in household income.²⁴ Research also supports this claim: Kahn and Matsusaka's analysis of environmental referenda in California reveals a positive effect of household income and education on the choice to support greater environmental protection.²⁵

²⁴ Thomas M. Selden and Daqing Song, "Neoclassical Growth, the J Curve for Abatement, and the Inverted U Curve for Pollution," *Journal of Environmental Economics and Management*, 29, no. 2 (September 1995) pp. 162-68.

²⁵ Matthew Kahn and John Matsusaka, "Environmental Demand: Evidence From California Voting Initiatives," *Journal of Law and Economics* (April 1997).

DOES TRADE INCREASE OR DECREASE ENVIRONMENTAL DEGRADATION IN THE SHADOW SECTOR?

Economic models of comparative advantage and specialization suggest that both individuals and nations become richer when they have the opportunity to trade with others. If international trade increases national income, then following the reasoning above, a nation that increases its trade may devote greater resources to environmental protection.²⁶ Conversely, trade may increase the demand for the shadow sector's output and thus encourage greater resource degradation in the unregulated sector. Thus, trade could be damaging by increasing exposure to external demand for degrading activities (in particular, if partial information makes regulation difficult). For instance, greater demand for resources or resource-intensive goods may increase strip mining of extractable resources. Or, if Asian demand for ivory from Zambia is high, then increased trade between Asia and Zambia may translate into increased degradation of wildlife stocks.

Economists have identified three impacts of growing world trade on the environment. These have been labeled "scale, composition and technology effects."²⁷ Regarding composition, there is concern that international trade will lead to poor countries becoming "pollution havens."²⁸ Poor countries may choose to develop by specializing in highly polluting activities, that is, by shifting production towards goods that are "dirty" to produce (note that firms may make this choice more often if informational shadows lower the risk of being fined). However, the empirical literature has found little evidence that poor countries are becoming major pollution havens (perhaps attributable to transportation costs over long distances).²⁹ For technology, trade may lead to technology transfers to developing countries from wealthier countries that are not only more productive in terms of output, but also relatively "cleaner."

Also, greater international integration may increase

²⁶ Jagdish Bhagwati, "The Case for Free Trade," *Scientific American* (November 1993) pp. 41-49.

²⁷ Brian Copeland and Scott Taylor, "North-South Trade and the Environment," *Quarterly Journal of Economics*, 109 (1994) pp. 755-787.

²⁸ Judith Dean and Patrick Low, eds., "Trade and the Environment: A Survey of the Literature," *International Trade and the Environment*, World Bank Discussion Papers, no. 159 (1992).

²⁹ See, for example, Matthew Kahn, *United States Pollution Intensive Trade Trends From 1972 to 1992*, (Columbia University mimeo 2000), where he investigates the pollution content of US trade over time.

environmental protection if citizens of developed countries are willing to pay to protect environmental assets. Eco-tourism is a prime example: US citizens who will pay to visit an African wildlife area provide a monetary incentive for African villages to preserve wildlife (for example, to monitor anti-wildlife activity within the village). Or, since citizens of developed countries may be concerned about the deforestation of the Amazon, the creation of new markets and trade in forest preservation (that is, payments for carbon sequestration under the Kyoto Protocol,³⁰ pharmaceuticals or sustainable wood products) may create new methods to finance protection of forests. In shadow economies where local citizens may have the best information, it is important to recognize that this creates local incentives to monitor.

Greater openness may also increase the likelihood that global environmental treaties are signed and enforced. This can be viewed as benefits to trade within international relations; countries that are in contact with each other can bargain through "issue linkage." For instance, the US held out on ratification of NAFTA, and thus withheld economic benefits from Mexico until language was added to the treaty regarding environmental protection within Mexico. Since Mexico could do whatever it wanted to do within its own borders regarding the environment, it had to be "paid" with economic benefits in order to do what the US preferred. Generally, we can think of sovereignty as entitlement to property rights that sets up Coase Theorem bargaining once countries are willing to have dialogue. Another example of this is that China can do as it wishes with Chinese coal, even if its airborne emissions affect Japan. We might expect, then, that the wealthier country will "pay" in negotiations; for example, Japan can give China cleaner coal technology. However, we must recall the shadow-economy perspective on this point about integration. When a country has the best information about activities within its own borders, it may be that monitoring of such treaties is difficult, since monitoring across borders inherently takes place "in the shadows."

³⁰ Forests capture carbon and store it in the plant material. Under the Clean Development Mechanism of the Kyoto Protocol, countries required to reduce Greenhouse Gas emissions would pay poorer unrestricted areas to permit forestry growth (through protection, for example).

CONCLUSION

We began with the view that if household and firm activities have effects on others not involved in those activities, then unregulated private choices lead to socially inefficient outcomes. Further, efficient regulation of those activities requires a fair amount of information. This suggests the difficulty of environmental regulation that would achieve a socially efficient balance of consumption and environmental protection in countries featuring significant shadow sectors.

Thus, in shadow economies, where one defining property is that much of the economic activity is not observed (or at least not officially observed), we must expect that policy limitations may be severe. We suggested, though, that even if no information exists, there are actions a regulator or government could take to influence individual decisions regarding their damaging activities, and therefore influence environmental outcomes. These policy actions can lower the returns from damaging activities and raise the returns of alternative activities.

Also, when less-than-ideal information may be available, a regulator could use this information to set incentives for cleaner activities and for those regulated to produce additional information. In addition, if government regulation is simply not feasible or cost-effective, recent experience has suggested that some informal "regulation" can be achieved by providing the information that exists about firms to the public, who may then confront the firms. Further, private actors such as NGOs may be able to get better information than the government, and may act in concert with private individuals to efficiently manage commonly-owned local resources. In general, however, it appears that a socially efficient balance requires some level of regulation.

The final section of the paper considered effects of economic development on the environment and on generation of information for environmental regulation. We are conscious that consumption growth causes environmental degradation, and that the political process may not permit sufficient regulation to solve environmental problems that even citizens would like to address. For example, even if most voters preferred more regulation, lobbying and campaign donations might prevent it. On the other hand, we expect that increasing incomes will lead to greater preference being expressed for an improved environment, including the creation of a regulatory infrastructure that generates the information necessary

to roll back the shadow and achieve environmental goals.

FUTURE RESEARCH

Throughout this paper we have assumed complete integrity of environmental regulators seeking to achieve socially efficient balances by internalizing environmental effects. This simply may not be the case. While economic research has increasingly focused on government corruption, and more generally, on the potential gap between the agendas of regulators and their constituencies, we know of little research which focuses on the impact of corruption on enforcement of environmental regulation. Further, there is reason to be more worried about this in a shadow setting, where the actions of firms are difficult to observe.

The need for an actor with the public interest in mind, and perhaps also, better information than the government, is apparent. In this setting, local NGOs play an important role in investigating and publicizing environmental abuses; for example, “Days of Shame” can be used to discipline not only socially irresponsible firms but also socially irresponsible officials. How environmental accountability can be achieved “in the shadows” is an important area for further research. ♣